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MENTAL TESTS
A GENERAL SURVEY OF THE FIELD
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MENTAL TESTS: A GENERAL SURVEY OF THE FIELD

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Mental tests in their various forms have caught the attention of the general public so successfully, and are such a frequent topic of discussion in the newspapers and magazines now-a-days, that we are in danger of exaggerating the importance of the subject. Possibly a statement of the position of Mental Tests in the curriculum of a typical college will help to correct this tendency. At Mount Holyoke we offer ten courses in Psychology, most of them giving three hours of credit for one semester, thus making it possible for students to take thirty hours of Psychology. The work in Mental Tests counts as one semester hour, i.e., it is only one-thirtieth of the possible work in Psychology, a matter of about 16 lectures and class discussions. This evening I am hoping to give you an introduction to the main topics and problems treated in this one-hour course, hoping to fill in the details and give a chance for general discussion in the Round Table to be conducted later by Mr. Hamilton.*

By a mental test, we mean the scientific measurement of some mental trait or capacity. Just as we can measure the resistance of a bar of iron, or the specific gravity of a fluid, the rate of respiration or of heart beat, the strength of one's grip or the speed of one's response to a stimulus, so can we also measure the efficiency of memory, the richness of imagination, the degree of attention, the ability to reason correctly, etc.; and the measurements of these latter functions are called "mental tests."

The superiority of measurement over casual observation has long been recognized in dealing with physical relations; mental testers claim the same superiority for measurement in the mental sphere. In the smaller communities the iceman still guesses at the weight of the cake he puts into the icebox; in many kitchens the cook still puts in "a pinch of this and a pinch of that and salt to taste"; bananas and eggs are still sold by the dozen, regardless of size and weight, in some parts of the country. But the "tried recipe" is fast crowding out guesswork from the kitchen, and in dealing with the iceman, and the grocer, as well as the gasman and the electric light company, measurement is fast becoming the rule of life. The methods of science, which have revolutionized man's attitude toward nature in its manifold phases and contributed in notable degree to the efficiency of industry, and to the comfort of the home, are now being used to remodel and reorganize the schools. For it is quite as necessary and quite as feasible to measure mental traits as to determine the quantities of physical substances. An illustration will perhaps make this clearer.

Someone says "What a wonderful memory Mr. A. has! You go into his store and ask him the price of dozens of articles and he never hesitates or makes a slip on any of them. I wonder how he is able to do it?" Perhaps during the same day you hear Mr. A.'s wife complaining that she can never depend upon him to bring home things she asks him to get in town, following her statement by specific illustrations of memory lapses which have caused her great inconvenience and Mr. A. great embarrassment. Now has he, or has he not, a good memory? Casual observation gives

*Supt. C. A. Hamilton, New York StateSchool for the Blind, Batavia, N. Y.

conflicting evidence. What has science to say about it?

We must first define our terms. What do we mean by "memory?" The modern scientific study of the mind has made it quite plain that memory is not a "thing" that one "has" and "uses" as one may have and use a horse, or a muscle, or any other physical tool for producing results. Psychology has analyzed memory into four distinct processes or elements, each of which may be tested separately, and each of which may be good or bad independently of the other three. People have different methods and show different degrees of efficiency in (1) learning, (2) retention, (3) recall, and (4) recognition, and it is as foolish to confuse these four-part processes as it would be to glance at a group of four men who look successful and say, "There is a fine group of American citizens," for the manufacturer may be a profiteer, the minister a time-server, the physician a quack, and the lawyer a crook! The differences are not obvious to casual observation, but scientific measurement demonstrates them beyond a doubt. It makes a tremendous difference in the efficiency of our memory whether we use the logical or the rote method of learning, whether we employ visual, auditory or tactual imagery to assist us in retention, whether we give our full attention to the items to be recalled, etc. Probably Mr. A. has found that it is essential to his success in business to have prices at his tongue's end and by **repetition** under **attention** he has found it possible to gain a marked proficiency in this activity: but like many men who leave home after a hurried breakfast, full of plans for the work of the day, he answered "Yes, of course" to various things that were said to him by his wife without giving full attention to the items, and without weaving them into any active associated ideas that would assist in their recall at the proper time later in the day. Science could go still further and measure each of the four memory processes separately, but it would seem that our preliminary analysis justifies us in saying that in Mr. A's case the trouble is with his interest and his attention rather than with his memory. In other cases actual measurement seems more satisfactory. For instance, we demand of telephone operators a high degree of native retentiveness so that they can remember the numbers we give them without too much repetition, and we now have methods of testing native retentiveness which are valuable in prophesying the probable success or failure of applicants for positions in such work, thus saving the expense of the period of apprenticeship which has formerly been necessary.

Before taking up our study of the different types of mental tests now in general use, it will be advantageous to glance briefly at the history of the testing movement, especially during the last thirty-five years, when a definite impetus to measurement has come from the development of individual psychology, that branch of the science which emphasizes the differences between individuals of different ages, races, sexes, etc., and seeks to determine the influence of environment and education upon the individuals studied.

Three fairly distinct periods may be distinguished, (12)*. I will characterize each in a few words, and give typical illustrations of the lines of work attempted.

*Note: Figures in parenthesis refer to articles listed at the end of the paper.

1. The period of invention, description and trial. 1890-1904. This period is characterized by the invention, description and trial of a large number of miscellaneous tests, with little analysis of the tests themselves, of the functions tested by them, or of their relation to each other. Typical attempts:

1890 Mental measurement of college students—Cattell.

1893 Mental differences between races—Jastrow.

1894 Mental differences characteristic of age—Gilbert.

1895 Classification of defectives by use of tests—Kraepelin.

1903 Mental traits of the sexes—Thompson.

1905 Classification and segregation of retarded children—Binet-Simon.

2. The period of specialization and standardization. 1904-1916. The chief aims of this period were (a) to stereotype the methods of giving and scoring tests, (b) to establish norms according to age, sex, environment, etc., (c) to specialize tests for specific purposes, and (d) to test the tests themselves, scientifically. Typical publications:

1903 Stern's Criticism and Appeal for Scientific Standards.

1904 A Collection of 50 Tests, by Toulouse, Vaschide and Pieron.

1909 Whipple's Manual of Mental and Physical Tests.

3. The period of practical and vocational application, 1916 to date. The use of group tests, begun early in the second period, was greatly developed in the second. The schools quickly recognized the great advantage of such tests for general surveys, and when the U. S. entered the World War, the necessity for the mental measurement of the draft army led to the greatest experiment in mental testing ever undertaken. After the war, industry sought to use the methods devised for the army, and tests for vocational guidance in the schools and selection of employees for industry enlisted the efforts of a host of enthusiastic workers.

I. Intelligence tests (5)

1. Individual tests of intelligence.

The Binet - Simon tests assembled by two French psychologists, A. Binet and H. Simon, (1) to meet the need created by a Paris ordinance requiring the segregation of inferior children, were first published in 1905, and revised by the authors in 1908 and again in 1911 to meet criticisms resulting from their use in France, Belgium, Germany and England. The tests were first extensively used in America by Goddard in 1910-11, and have been revised and adapted by various American psychologists, the most important revisions being Kuhlmann's in 1912, the Yerkes Point Scale in 1915, and Terman's extension and standardization (The Stanford Revision) (9) in 1916. An enormous literature has grown up about the tests in the past twenty years, and a very extensive use has been made of them with such widely varied groups as school children, delinquents, immigrants, policemen and firemen, the unemployed, the American draft army, high school and college students. At one time it looked as though we should soon have a new profession established in America, the "Binet-tester" or "Binet-er," so persistent was the demand for the testing of school children and delinquents. We have at present a vast amount of data upon the development and mental abilities of children of all ages, and we know about what to expect of children—at least we know what large numbers of children are able to do and assume that this attainment is normal for any other child whose heredity and environment have not unduly helped or hindered him in his development.

But, of course, we must make special concessions to children whose chances have been above or below the average. It was early pointed out that the Binet - Simon tests make a considerable use of school knowledge and that success in passing the tests depends largely upon ability to understand and use the language in which they are given. To test the native ability of street gamins and juvenile delinquents, immigrants who do not know our language, and the deaf, who are not only handicapped in communication but whose thought life has had a very different development from that of people who acquire speech naturally, special types of intelligence tests called "performance" tests (6) have been devised, which aim to meas-

ure the same mental functions as those measured by the Binet-Simon tests, but without the use of words or verbal imagery. The modification of the Binet-Simon tests for use with the **blind,** begun by Mr. R. B. Irwin in 1914 and now being standardized by the writer, is doubtless familiar to this audience.

2. Group tests of intelligence.

Although psychologists here and there had made group tests of mental functions long before the publication of Whipple's Manual (10) in 1909, the first extensive tests of intelligence by the group method began with the publication of the Otis and the Pressey tests in 1916. (The Pressey Group Point Scale was adapted for use with the blind and employed in a survey of eight eastern schools for the blind in 1919-20). The Army Alpha test (14) was given to 1,789,000 soldiers during 1917 and 1918, and the National Intelligence Tests, devised by a group of psychologists who had taken an active part in the army testing, financed by an appropriation of $25,000 from the General Education Board and published for use in the schools in 1920, bid fair to rival the Army Alpha test in extent of use. Large numbers of other tests have been prepared (13) and so generally used that competent judges now estimate that about five million school children have been tested. The methods have been so well developed that it is now possible to test in a single day all the pupils of a school having as many as ten rooms, and to have a thousand papers scored in a few hours by clerks and teachers. Surveys of as many as 200,000 children are now being planned! The newspapers are full of test items and many of them publish "brain tests" every morning, so that their readers may measure their minds before breakfast, if they prefer this sort of exercise to the "daily dozen"! I wish it were possible for you all to look through the collection of sample tests I have assembled for use with my classes in college. I shall bring these collections to the Round Table discussion. Meanwhile, the best I can do is to call your attention to two tests I have mimeographed and passed out with the outline for this lecture—a "best answer" test from the Army Alpha series, and a "completion test" devised for Dartmouth freshmen.

To meet the language difficulty mentioned in connection with the Binet-Simon tests, many non-language performance tests have been arranged for use with groups, the first well known test of this sort being the Army Beta tests (14) for illiterate soldiers. We have now quite a collection of group performance tests intended for kindergarten and primary children, who have not yet learned to read and write, and at least one performance test which claims to measure native intelligence all the way from the kindergarten to the university.

3. Criticisms of the test movement.

Of course a movement involving so many people and such diverse activities could not fail to encounter opposition. The "Binet-testers" were said to be worse pests than life insurance agents, the tests were branded as foolish puzzles, as a useless waste of time for the pupils and an unjustifiable waste of money for the schools. Newspapers which delighted in reporting the most extravagant claims of some misguided enthusiast in one part of their issue, would print a serious editorial criticism of something they had failed to comprehend in another part of the paper. Of course individual psychologists and schoolmen have made mistakes, for we are all human, but I believe that when the last word is said it will sound less like Walter Lipman's ill-advised attack upon a scientiffic movement he does not understand and more like Whipple's defense of the testing program. (11) Let me quote his summary: "The pupils are happier; the pupils are more successful; the teachers cooperate; better methods of instruction are appearing; the parents are appreciative. Does this sound like inflicting crim-

inal injury upon children, or disgracing families, or threatening the foundations of democracy?"

I cannot help feeling that a considerable part of the opposition to mental testing is emotional rather than reasoned. Some people are always ready to oppose anything new. One expects opposition from the ultra-conservatives or "neo-phobiacs" as someone has recently named the group: they are afraid of anything new, for it may be dangerous and it clearly is disturbing to the calm continuance of what we are accustomed to. Others have tried a few tests timidly, failed largely because they did not have confidence in themselves and then wept with sympathy for the poor school children who are being similarly abused by the pernicious testers! But every movement has had to meet the conservative and the fearful. I am firmly convinced that mental testing is not a passing fad, but a permanent advance in our treatment of human nature. The testing movement embraces a large group of careful, cautious and open-minded scientists, quite as capable of criticising their own methods and improving their technique as they are fertile in devising new methods for meeting new issues. Tests and testing will go on improving just as automobiles and air-ships and radio outfits will go on improving. Tests have come to stay, and the sooner carping criticism gives way to appreciation and constructive suggestion, the better for all parties concerned. I am happy to second the hope voiced by Mr. Bledsoe, in his presidential address to this convention, "that this group may not fall behind any other educational group" in any worthy movement.

II. Educational or "achievement" tests (7).

Some psychologists reserve the words "Mental Tests" for tests of intelligence only; it has seemed to me wiser to follow the commoner usage, and include under "Mental Tests" all the various ways devised by psychologists for measuring the results of mental activity. Intelligence tests are supposed to measure one's native ability with a minimum of dependence upon the specific facts learned in school; "achievement" tests are planned to measure one's attainment in the different school subjects. In both types of testing certain scientific methods developed by psychologists are used: a) the details of giving the tests are carefully stereotyped; b) objective and time-saving devices for scoring are employed; c) comparisons are made with norms and standards established through a wide use of the tests.

In the early days of testing everyone had his own arithmetic test (8) and his grammar test, his spelling test and his geography test, and there are still large numbers of tests for all the school subjects from reading to sight-singing and millinery! (4) When I undertook to make a survey of schools for the blind in 1917 there was already a considerable number of such tests to choose from, and now their number is legion. But within the last couple of years a decided advance has been made in the publication of "teams of tests" for school surveys—a set of standardized tests which covers practically all the work of the grades, at moderate expense and with only two hours of testing, yields reliable evidence of a child's status in each of his major subjects, indicated by his "subject age", and of his general position, indicated by his "accomplishment ratio", obtained by dividing his "educational age" by his "mental age."

Am I piling up technical terms too rapidly? Let me pause a moment and give a few definitions, for the benefit of those who may not have been reading the later literature on testing. In the early days of intelligence testing it seemed desirable to use different phrases to indicate the mental status of the children tested and "mental age" was adopted to indicate the intellectual level a child had attained regardless of his actual or "chronological" age. Thus a child would be accorded a mental age of nine years if

he could pass all the tests through the nine year group, all the tests of the eight year group with some in the ten year group, or some other combination which would give him a total number of tests equal to the number expected of a nine year old. Such a child might have a "chronological" age of 7, 8, 9, 10 etc. years, and by dividing his mental age by his chronological age a new figure, the "intelligence quotient", commonly written I.Q. was obtained. A child testing at 9 who was actually only 7 would then have an I.Q. of 1.28; if he were 8 years old his I.Q. would be 1.12; if he were 9 years old his I.Q. would be 1.00; if he were 10 years old his I.Q. would be .90; if he were 11 years old his I.Q. would be .80, etc. All children with I.Q.'s of about 1.00, or 100 as it is commonly written, would then be classed as normal; those with I.Q.'s well above or below 100 would be classed as above or below normal, respectively.

A similar series of phrases has recently been coined for use in interpreting the results of tests of achievement in school subjects. Just as mental age signifies the mental or intelligence level a child has reached, so "educational age" is used to signify the level he has reached in his school work, and is determined by comparing his scores in a series of tests in his school subjects with the scores obtained by large numbers of other children. A child may have an "arithmetic" age of 9, a "reading" age of 10, a "spelling" age of 8, etc., because in each of these subjects he does about as well as the average 9, 10 and 8 year old, respectively. Combining all his scores and comparing them with the standards we then get his educational age, which may be nearly the same as his mental age and his chronological age, or may be widely different from both. A bright child who is unwilling to apply himself or who has been absent a great deal on account of sickness might have a chronological age of 7, a mental age of 9, and an educational age of 8 or lower, for instance, while a dull child of great industry might have a chronological age of 9, a mental age of 7 and an educational age of 8, etc. An "educational quotient" (E.Q.) may be obtained by dividing the educational age by the chronological age. The essential idea of all these phrases is of course to see what relation ability bears to achievement, and to use the suggestion gained from such measurements and computations in assisting the child to accomplish as much as he is able to do without strain or worry. Theoretically the "accomplishment ratio," obtained by dividing the educational age by the mental age, should approximate 1.00, and similarly the accomplishment ratio of a whole grade, obtained by dividing the average educational age by the average mental age, should approximate 1.00. If this figure falls much below 1.00, the individual or the grade should be attentively studied to determine the cause of the inferior achievement.

A very recent team of tests—the Otis Classification Test—makes these determinations still simpler and easier, since it tests both intelligence and achievement in one hour, yields a mental age and an educational age directly, thus giving the data for the calculation of the intelligence quotient, the educational quotient and the accomplishment ratio, and is accompanied by an Interpretation Chart from which the "Classification Index" may be conveniently read off. This Classification Index is an average of a pupil's I.Q. and E.Q. and seems to Otis the most valuable measure of a child's ability in answering all questions of grading, or of dividing grades into fast, average, and slow moving sections. I am hoping soon to be able to adapt such a team of tests for use with the blind, to supplement the Manual published in 1921.

III. Advantages to be derived from the use of standard tests of intelligence and of school achievement. (3)

The World Book Company, which publishes a large assortment of mental tests, recently sent out a questionnaire to 100 extensive users of tests.

Let me quote some of the replies received to two of the questions asked:

1. "What did the results of the tests show you?"

"That there is a wide variation in the ability and achievement of pupils of the same age and grade;

"That our school was above (or below) those in other parts of the country;

"That the pupils were poorly graded and poorly classified;

"That teachers' judgments of ability and achievement are often faulty and need to be supplemented by scientific measurement;

"That there is a great difference in the abilities of teachers to teach, and in the methods of instruction, and that such instruction is capable of improvement;

"That many bright children are being handicapped for want of opportunity to do their best work, and dull pupils are not fairly treated because they are being pushed beyond their ability.

2. "What benefits were derived from the tests?"

"Better adaptation of instruction to pupils' needs and abilities;

"Better classification, since groups were made more nearly homogeneous;

"A change in the attitude of the teachers, who became more interested in efficient instruction, individual differences, and scientific procedure;

"Bright pupils were given opportunity commensurate with their abilities and dull pupils were made happier through the elimination of unfair competition with their intellectual superiors;

"Improvement in school work and more regular promotions;

"A better school spirit, with less need for discipline;

"A better understanding of the school and its methods by parents;

"A discovery of causes of failure;

"A distinct saving of time and money in school management," etc.

The specific uses of intelligence tests and achievement tests I have listed on the outline which I have passed around as follows:

(a) Intelligence tests serve the following purposes:

1. The classification of pupils according to mental ability.

2. The identification of children of inferior intelligence, who should be eliminated from the regular classes.

3. The discovery of unstable mental conditions and other defects.

4. The determination of the probable cause of delinquency.

5. The selection of gifted children whose superior intelligence warrants extra promotion or special training.

6. The guidance of children in the choice of a vocation.

(b) Achievement tests supplement the intelligence tests in the following ways:

1. They supply definite standards of attainment in the various school subjects.

2. They give objective measurements of the work of pupils and grades.

3. They measure the progress of pupils from term to term and suggest improvements of methods, etc.

4. They may be used as incentives to improvement, since knowledge of results may stimulate both pupils and teachers.

5. They offer a basis for classification when combined with intelligence tests.

6. They furnish a basis for promotion and grading which is not influenced by prejudices for or against particular pupils.

7. They indicate which pupils need special attention.

IV. Tests of special functions, particular abilities and disabilities.

The collections of tests published in 1904 and 1909 provided for the measurement of psycho-physical functions, sensory acuity, attention, memory, reasoning, etc. The last few

years' attempts have been made to test the volitional and affective sides of life,—instinct, emotion, will, and other "character qualities." As these qualities are often more decisive for success in life than general intelligence many students of human nature feel that the climax of the testing movement is still far in the future and that when we can get some quantitative measure of industry, ambition, faithfulness, cheerfulness, and the whole series of traits which distinguish the superior from the inferior, mental testing will be as universally accepted as is the use of scales and tape measures for the determination of physical quantities now.

Brief mention should also be made of the attempts to measure quite complicated mental functions such as scientific ability, journalistic ability, musical talent, the appreciation of art and literature, and growth in religious feeling.

V. Vocational and trade tests.

Tests for vocational guidance have multiplied very rapidly during the last decade. In general these tests seek to measure certain fundamental functions which are believed to be necessary in the vocations studied. Obviously it would be foolish for a color-blind person to undertake a vocation where frequent discrimination of colors is involved, or for a deaf person to take a job which requires acute hearing. On the other hand the possession of certain traits—an unusually retentive memory, mechanical or musical ability, a prepossessing social address—seems to indicate special fitness for some vocations. Teams of tests believed to measure certain qualities needed in a given vocation have been devised and widely used for prospective stenographers, clerks, engineers, business men, telephone operators, motor-men, etc., and with considerable success, though this movement is still in its infancy. While the results have been on the whole satisfactory, it is generally recognized that these tests must for a considerable period be considered monitory rather than prophetic, i.e., it is much safer to advise a young man not to enter some vocation because he lacks some quality or ability necessary for success, (as in the case of color-blindness referred to above), than it is to advise a young man to enter some vocation just because he possesses in a high degree, some quality which will be needed in a given field.

Trade tests bear much the same relation to vocational tests that achievement tests bear to intelligence tests, —they are intended to measure attainment in some trade just as the achievement tests are intended to measure accomplishment in school work. Vocational tests, like intelligence tests, aim to measure fundamental, native abilities, previous to training.

Trade tests (2) received their first great impetus through the needs of an efficient army organization. When twenty electricians, or plumbers, or carpenters were required by some army unit in France, it was necessary to make sure that the men who had claimed expert knowledge of one of these trades could measure up to the standards, and trade tests were developed under the same scientific conditions that had made the intelligence tests so successful. After the war the army methods were carried over into industry and it is now feasible to test proficiency in a large number of trades and manual activities. Such tests may be of great value in selecting and promoting employees.

Finally, I must mention certain dangers and cautions in mental testing. How many ordinary citizens can manage a tape measure as well as an expert tailor? Is it any wonder then that in attempting to use a much more complicated device like a scale of intelligence tests upon the most complex organism of which we have any knowledge (the human mind), many and grievous mistakes have been made through carelessness, ignorance, lack of expert training, etc.? And of course the conservative public makes the most of every slip, so that careless work or too literal interpreta-

tion by one unskilled tester brings discredit upon the dozens of careful scientific workers in mental measurement. Moreover, there is admittedly a large chance of error in a single measurement of mental ability. The child brought in to be tested is not just a pure intellect which one may weigh and measure, but a living personality. He may coolly perform up to the full limits of his native ability, but in many cases he will not. Suppose he has just been in a scrape and is still stinging with a rebuke administered justly or unjustly by his teacher; suppose he has just failed in his lessons and been jeered at by his companions; suppose he is not well today or has not been properly fed; suppose that he is looking forward to an exciting baseball game as soon as he can escape from school; suppose any one of a thousand interests that may be at the moment more vital to the boy than this mental testing; how can we know that we are measuring the real boy? Certainly a uniform result on several different occasions must be a far truer measure than any one testing. In group testing it is customary to assume that about ten per cent of the subjects may be incorrectly measured; we have no such definite estimate for individual testing, but the error must be large, and is likely to be more serious as testers put more confidence in the results of individual tests.

The lack of satisfactory measurements of character qualities other than intelligence has often been mentioned and should never be forgotten in reporting the results of an intelligence test. Until this need is met, it is certainly the part of wisdom to supplement the results of tests with every other item of trustworthy information about the individual being studied. Dr. Fernald, of the Mass. School for the Feeble-Minded, lists 10 distinct fields of inquiry in the study of a personality—physical examination, family history, personal and developmental history, history of school progress, examination in school work, practical knowledge, economic efficiency, social history and reactions, moral reactions, psychological tests.

Many schools have not the facilities for such a thoroughgoing investigation, but considering how often the judgment of superintendents and principals determines the whole future life of the pupils studied, our aim should certainly be to gain the widest possible basis for these crucial decisions.

Numbers in parenthesis refer to books and articles listed at the end of the paper.

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